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(54) **TANDEM STEERING FOR A GRAIN CART**

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A01D 90/10	(2006.01)
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CPC ***B62D 13/00*** (2013.01); ***A01B 69/003*** (2013.01); ***B60G 5/02*** (2013.01); ***B60G 7/003*** (2013.01); ***B62D 13/04*** (2013.01); *A01D 90/10* (2013.01); *B60G 2200/44* (2013.01); *B60G 2300/04* (2013.01); *B60G 2300/07* (2013.01); *B60G 2300/08* (2013.01); *B60P 1/40* (2013.01); *B62D 63/08* (2013.01)

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CPC A01B 69/00; A01B 69/003; B62D 5/28; B62D 13/00; B62D 63/08; B62D 13/04; B62D 13/005; B60G 5/02; B60G 5/04; B60G 7/003

See application file for complete search history.

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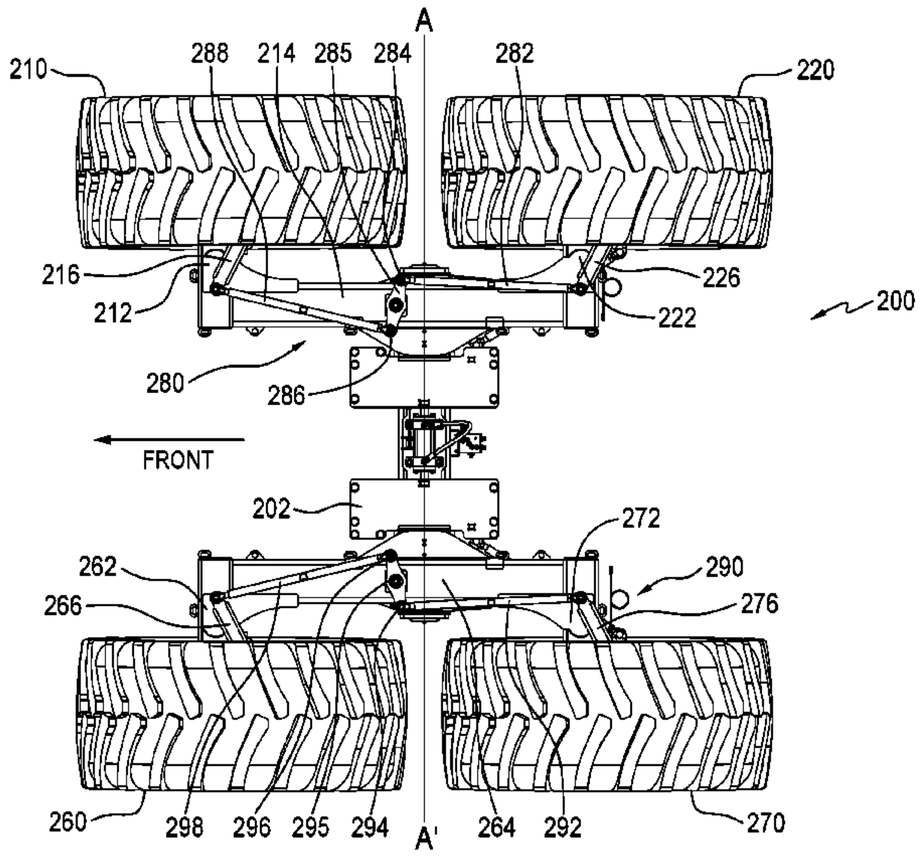
(57) **ABSTRACT**

A grain cart is provide having a wheel assembly with four ground wheels that all pivot in unison. The wheel assembly can include a first side front wheel, a first side rear wheel, a second side front wheel and a second side rear wheel. A first side steering link assembly can be operatively coupled between the first side front wheel and the first side rear wheel to cause the first side front wheel and the second side rear wheel to pivot in opposite directions. A second side steering link can be operatively coupled between the second side front wheel and the second side rear wheel to cause the second side front wheel and the second side rear wheel to pivot in opposite directions. A unison linkage assembly operatively can couple the movement of the first side rear wheel and second side rear wheel.

19 Claims, 10 Drawing Sheets



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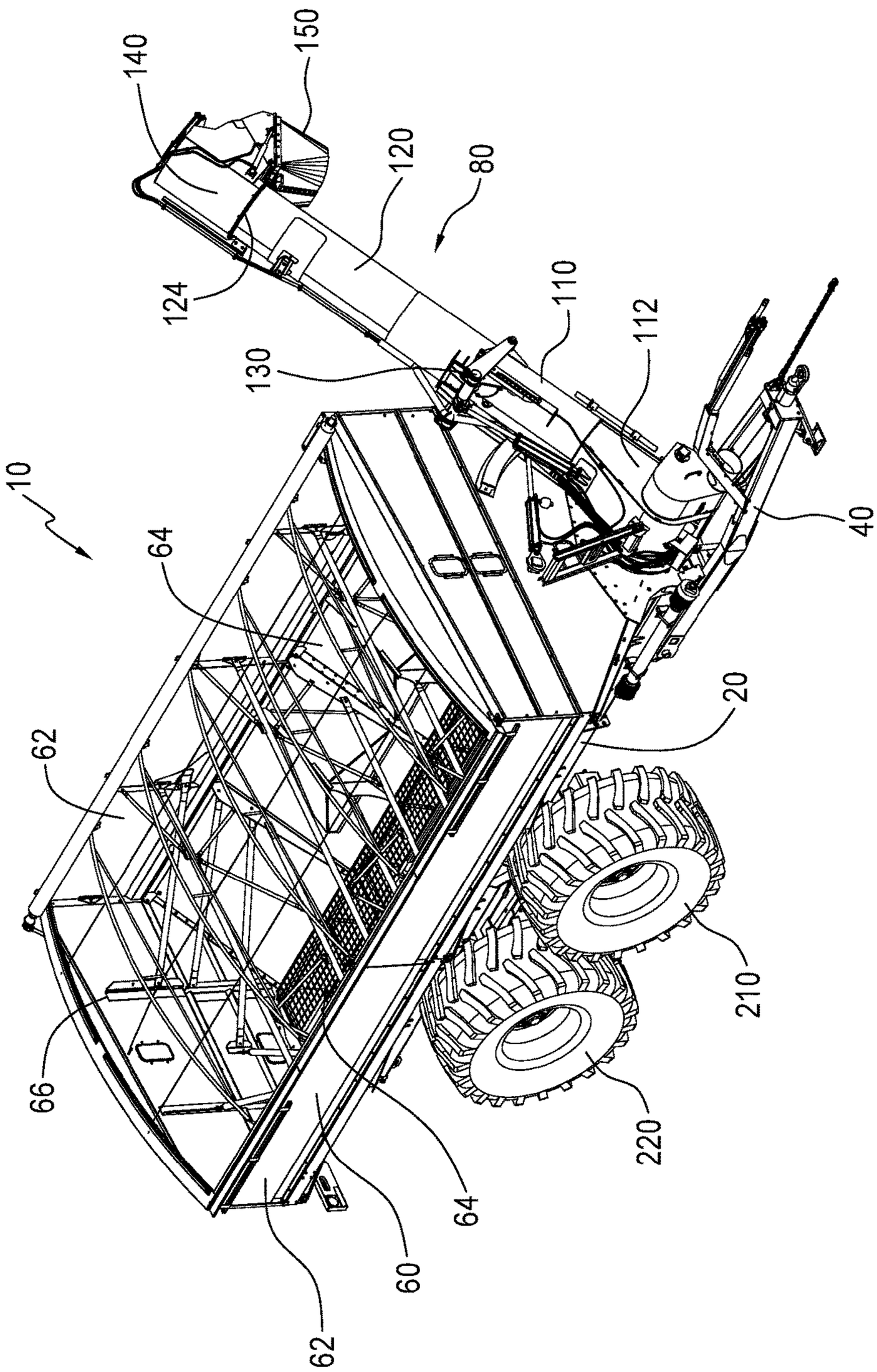

FIG. 1

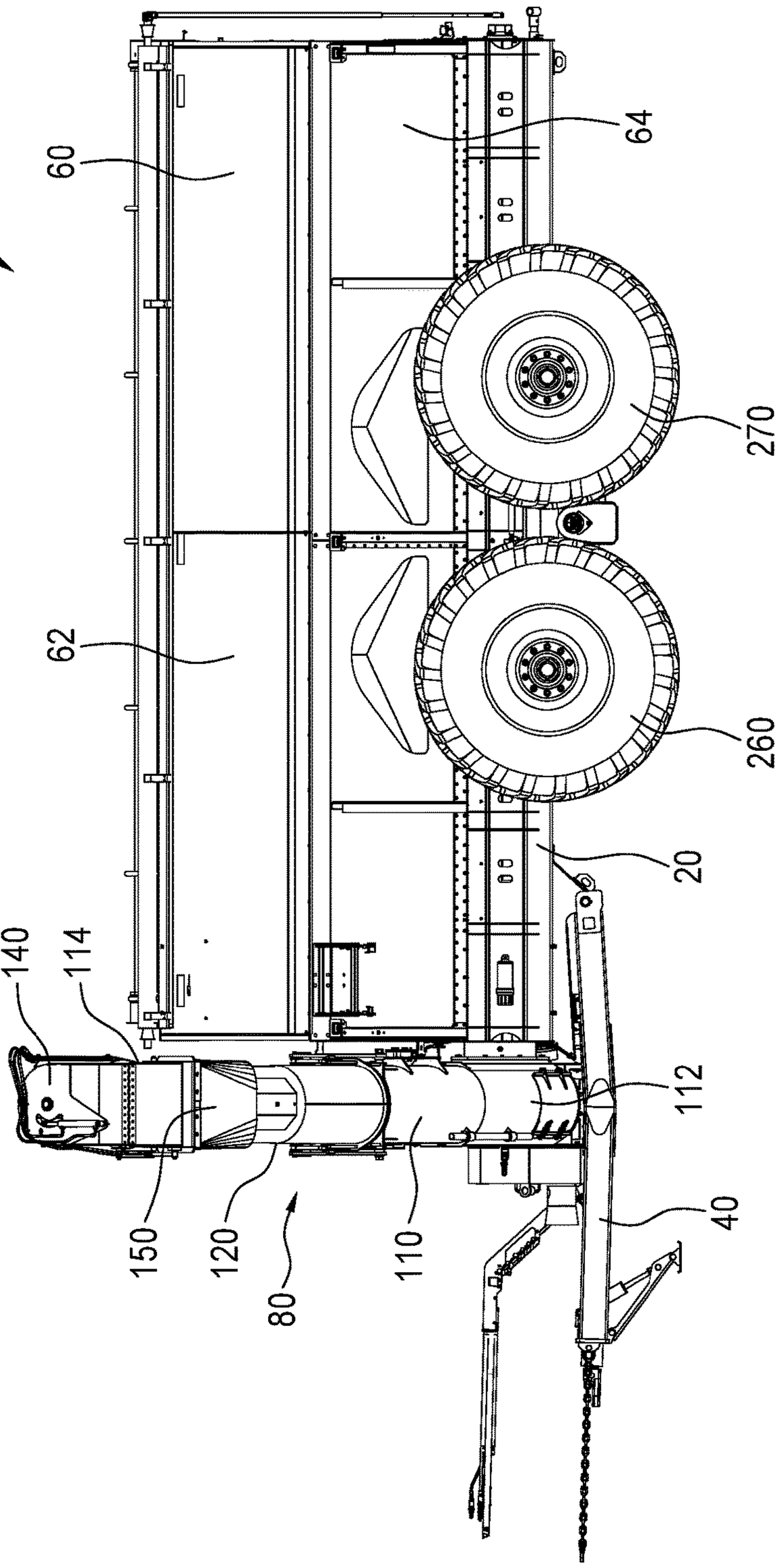

FIG. 2

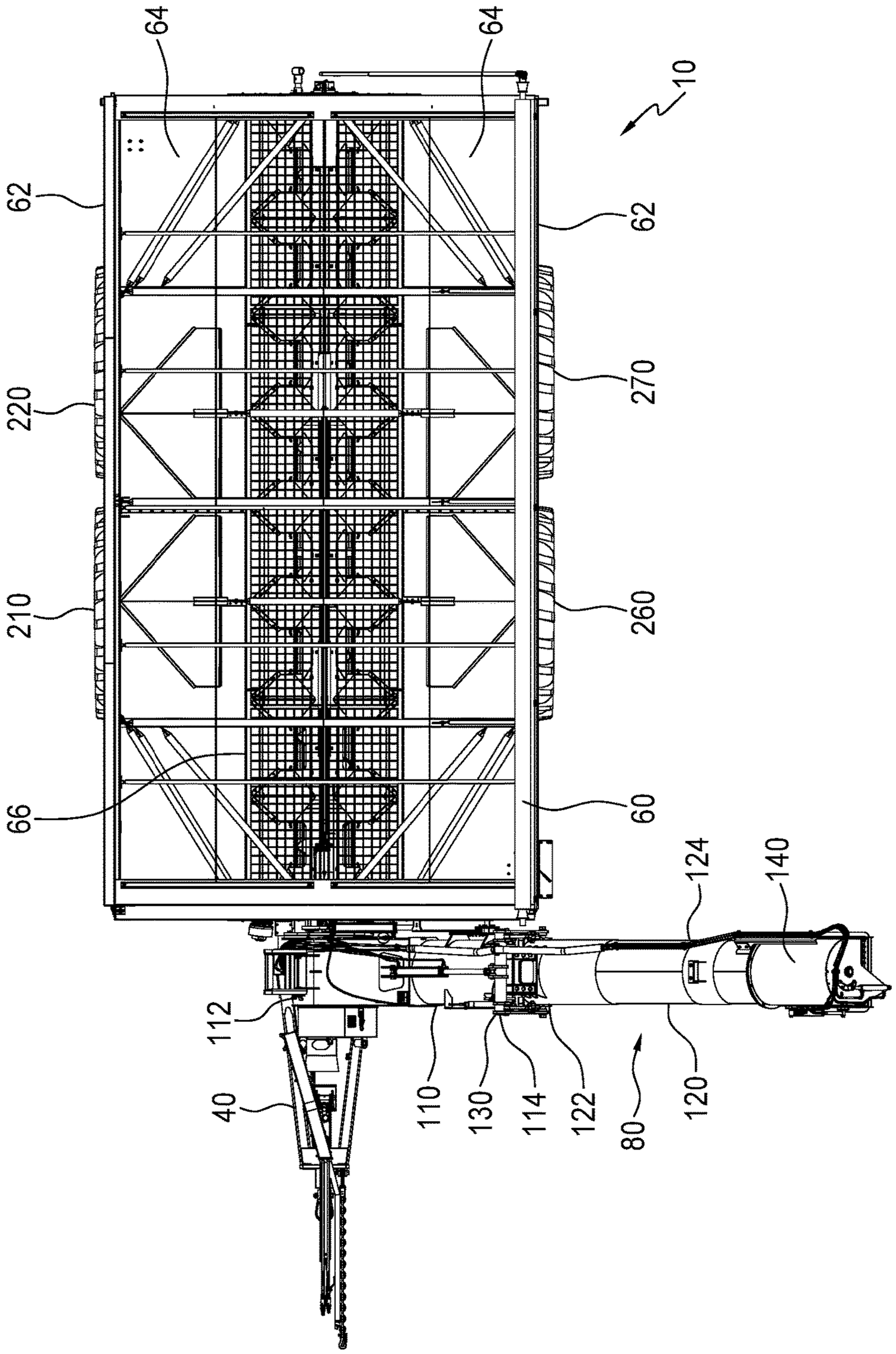
64
64
10
62
62
270
220
210
260
66
60
124
140
112
40
110
130
114
122
80
120

FIG. 3

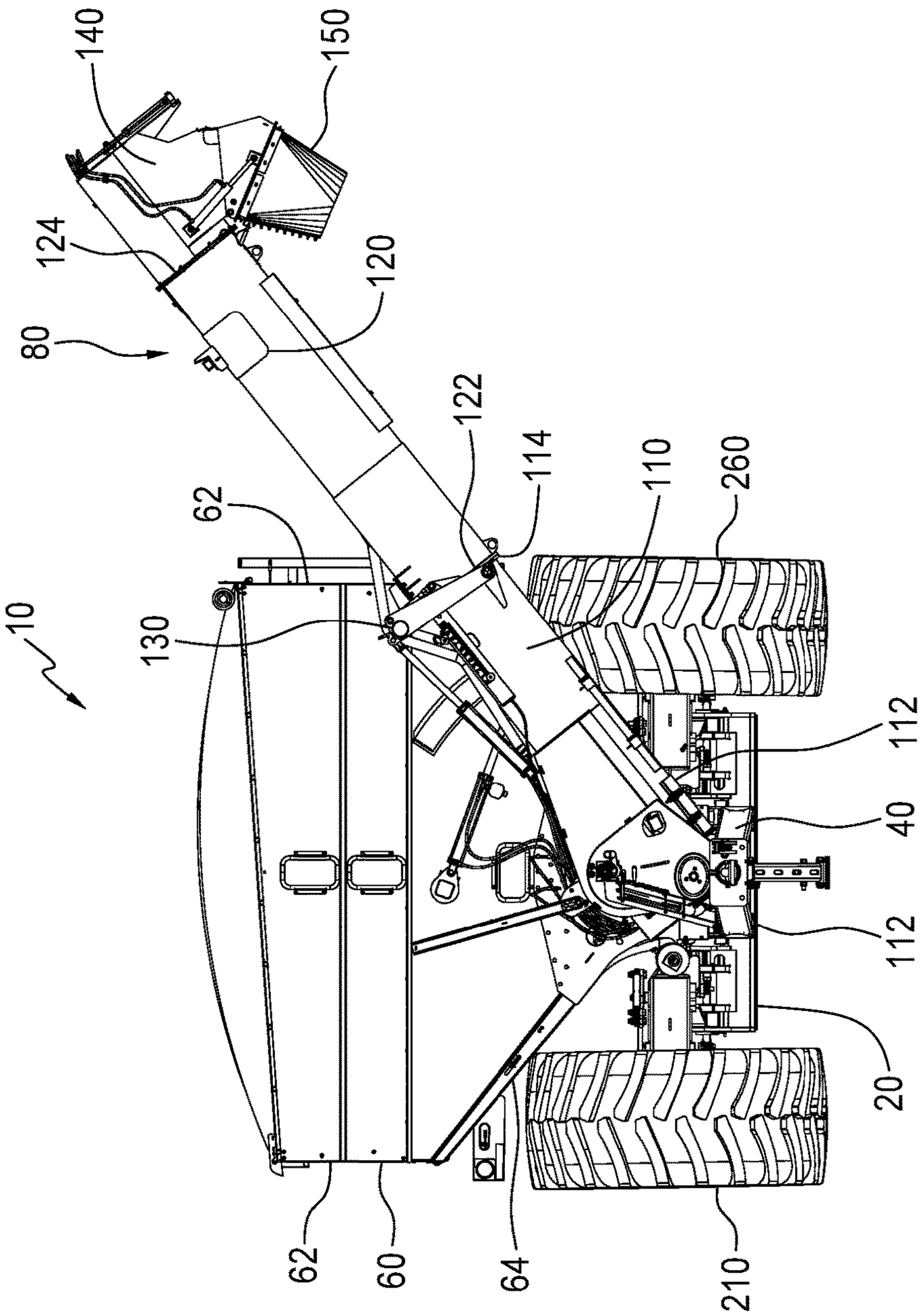
140
150
124
120
80
122
114
110
260
62
130
10
112
40
112
20
62
60
64
210

FIG. 4

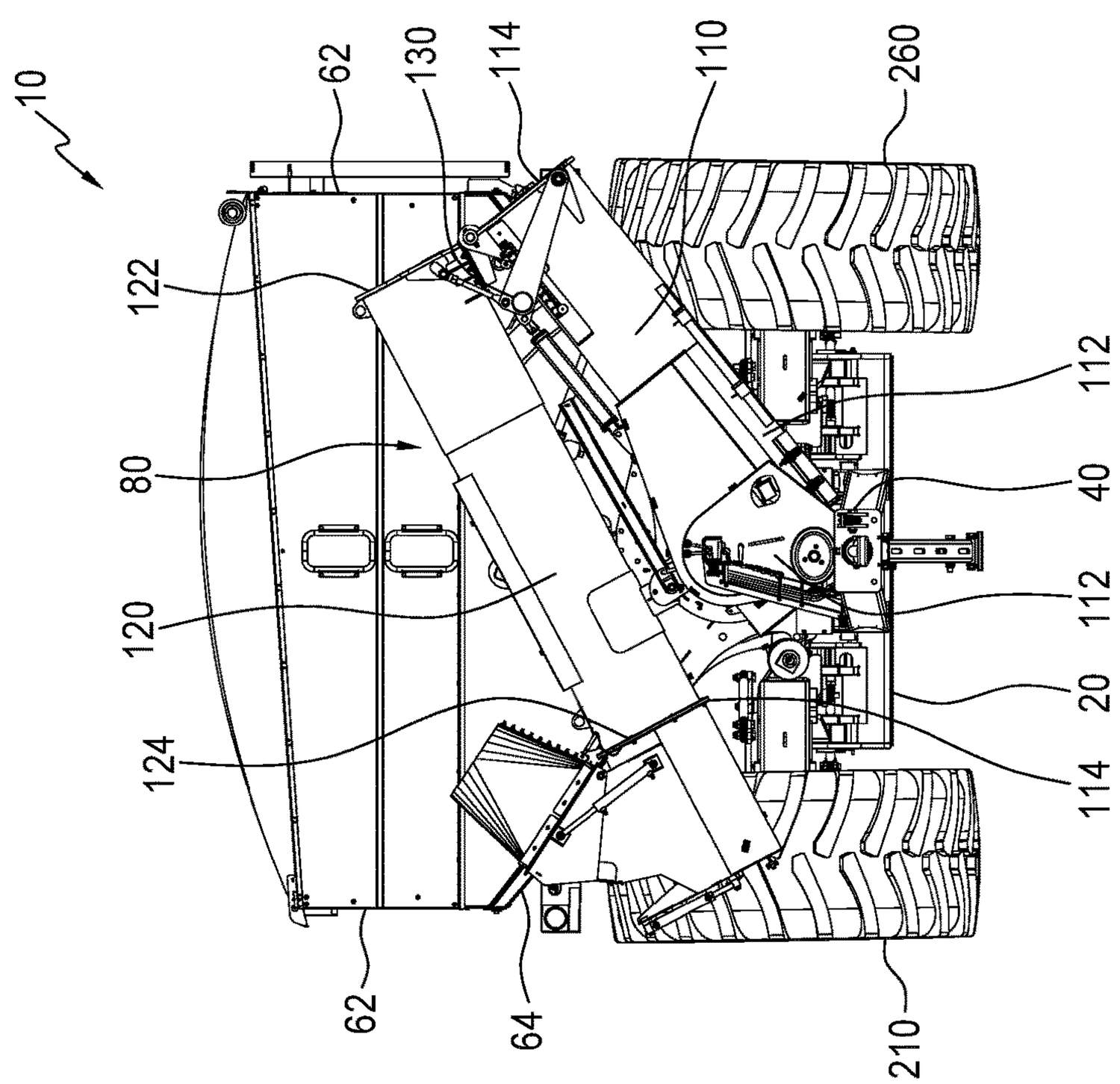

FIG. 5

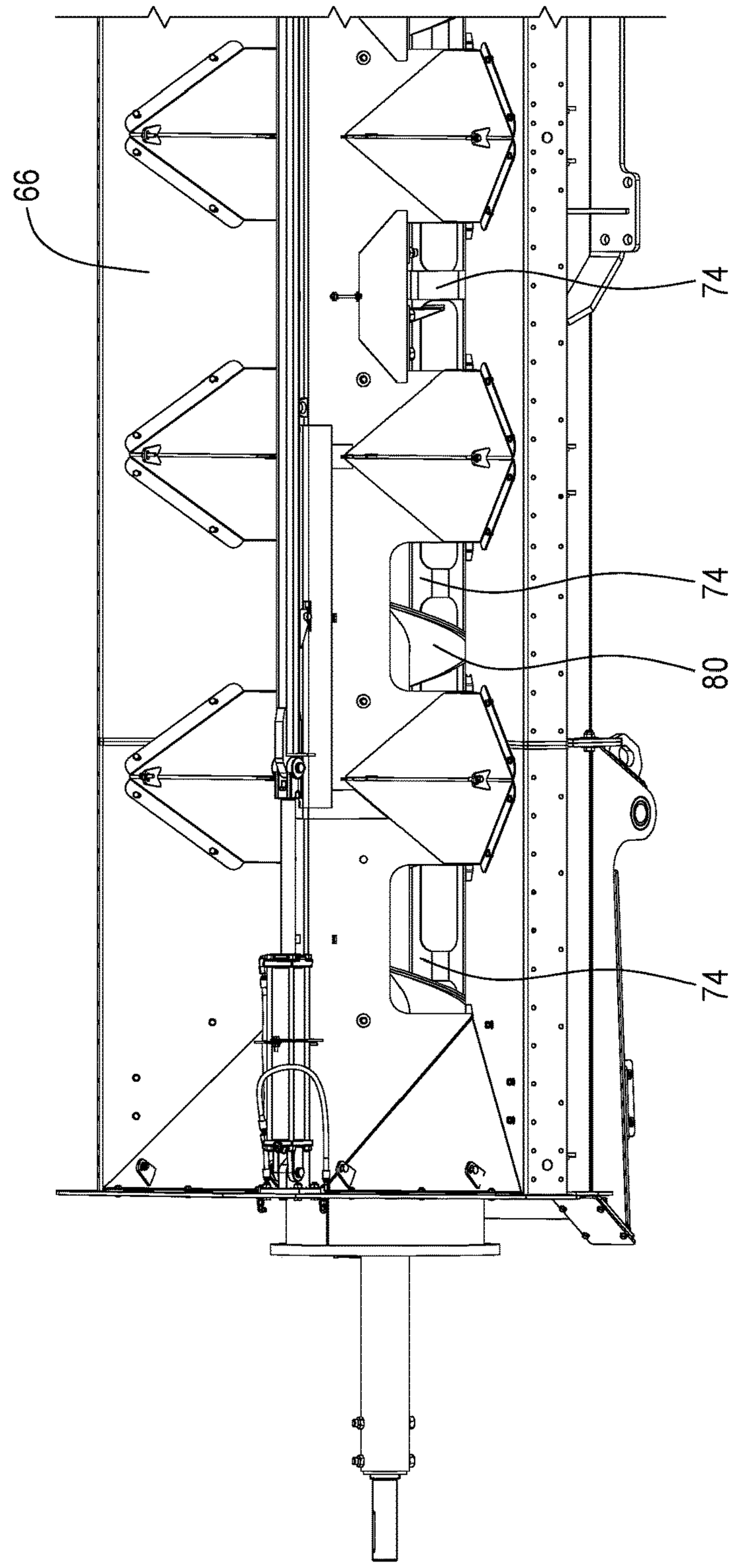

FIG. 6

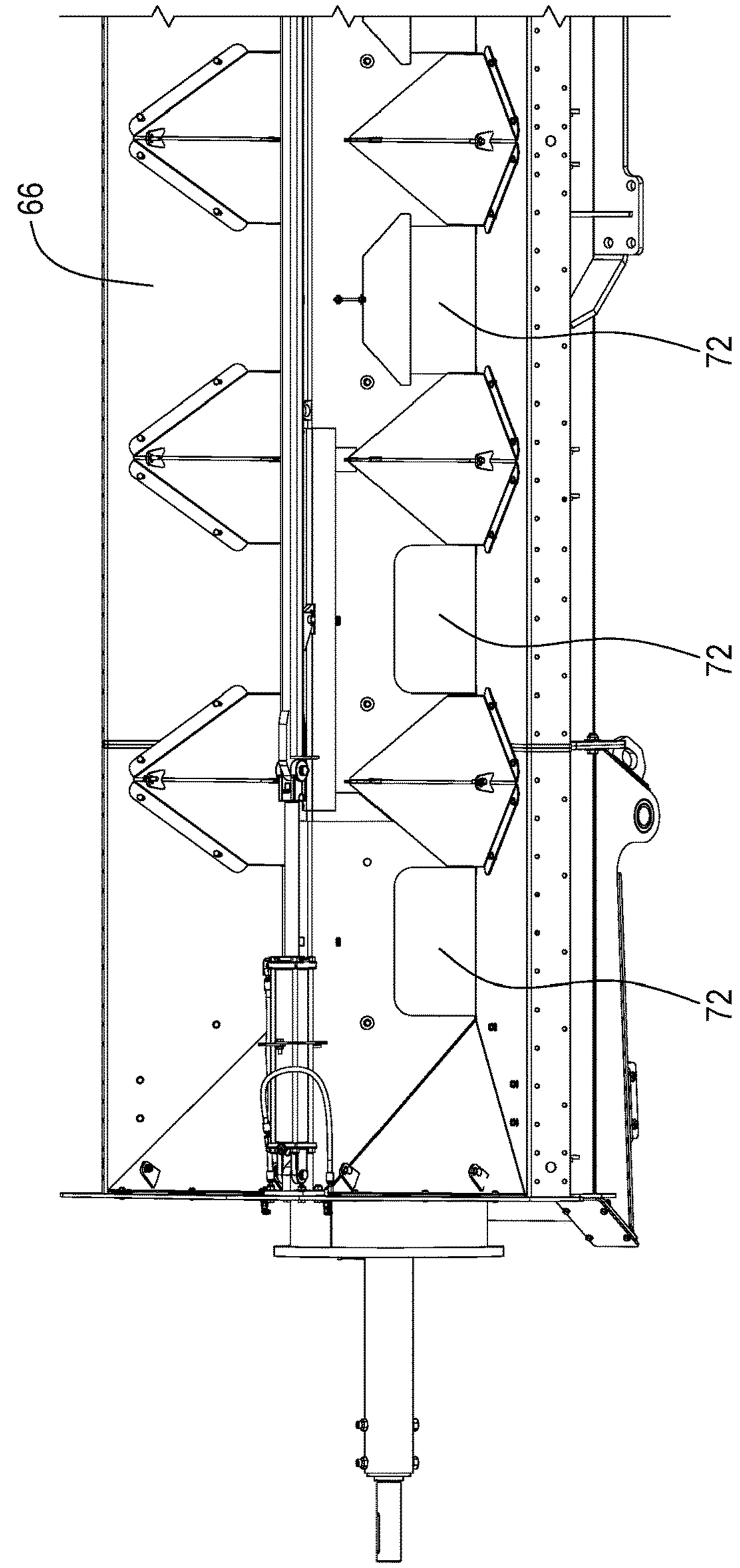

FIG. 7

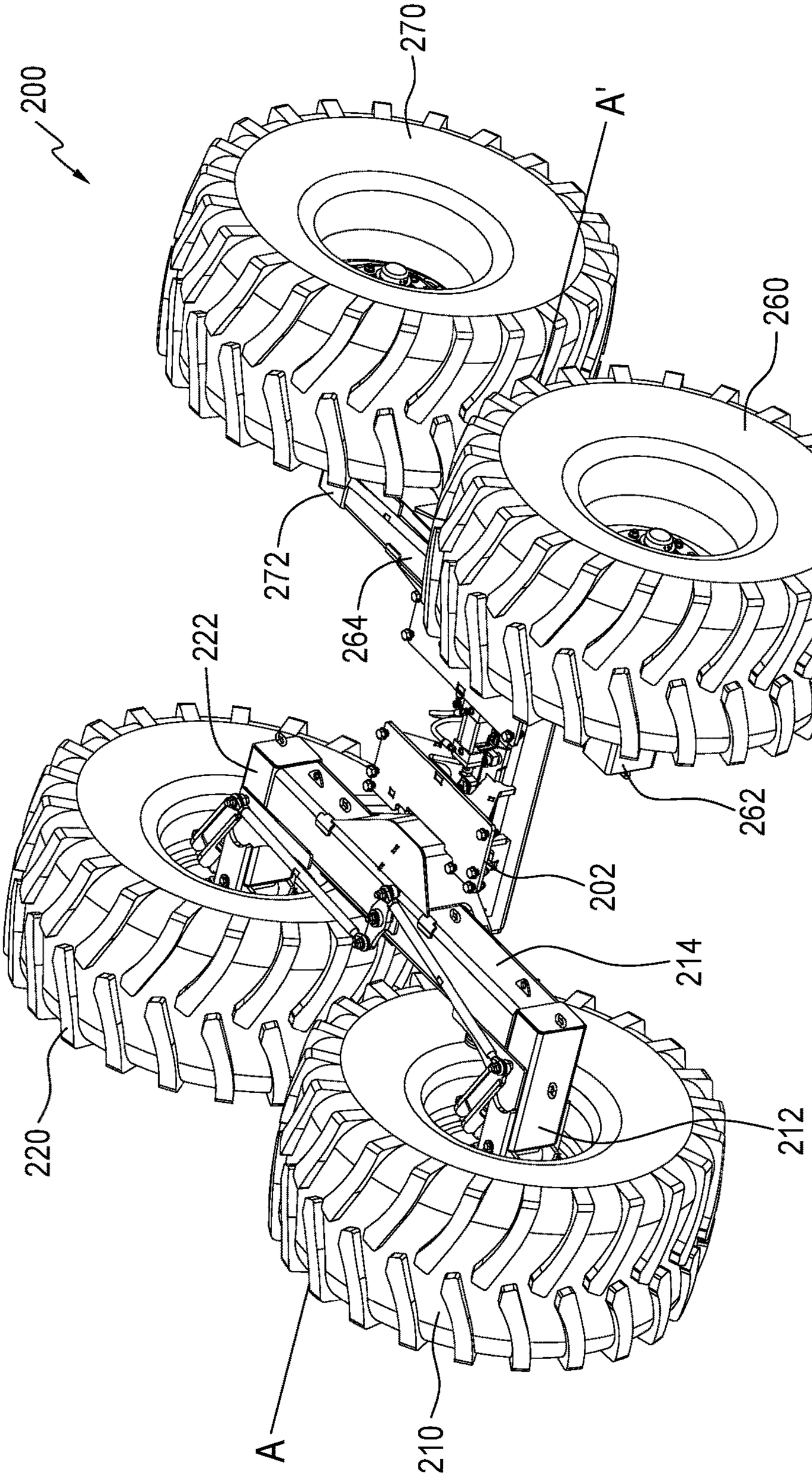

FIG. 8

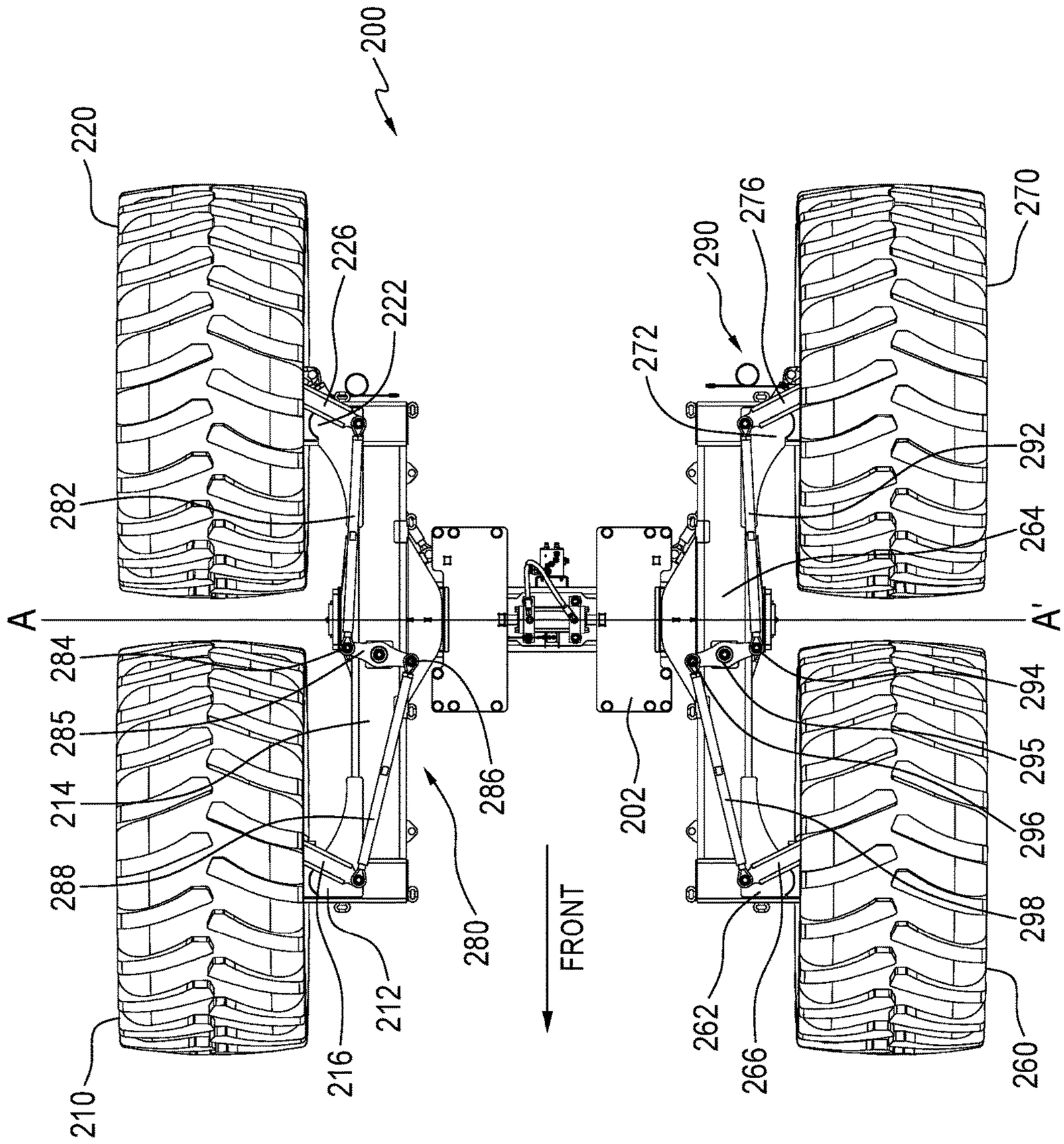
200
220
226
222
282
284
285
214
288
286
280
212
216
210
FRONT
A
A'
290
276
270
272
292
264
294
295
296
298
202
262
266
260

FIG. 9

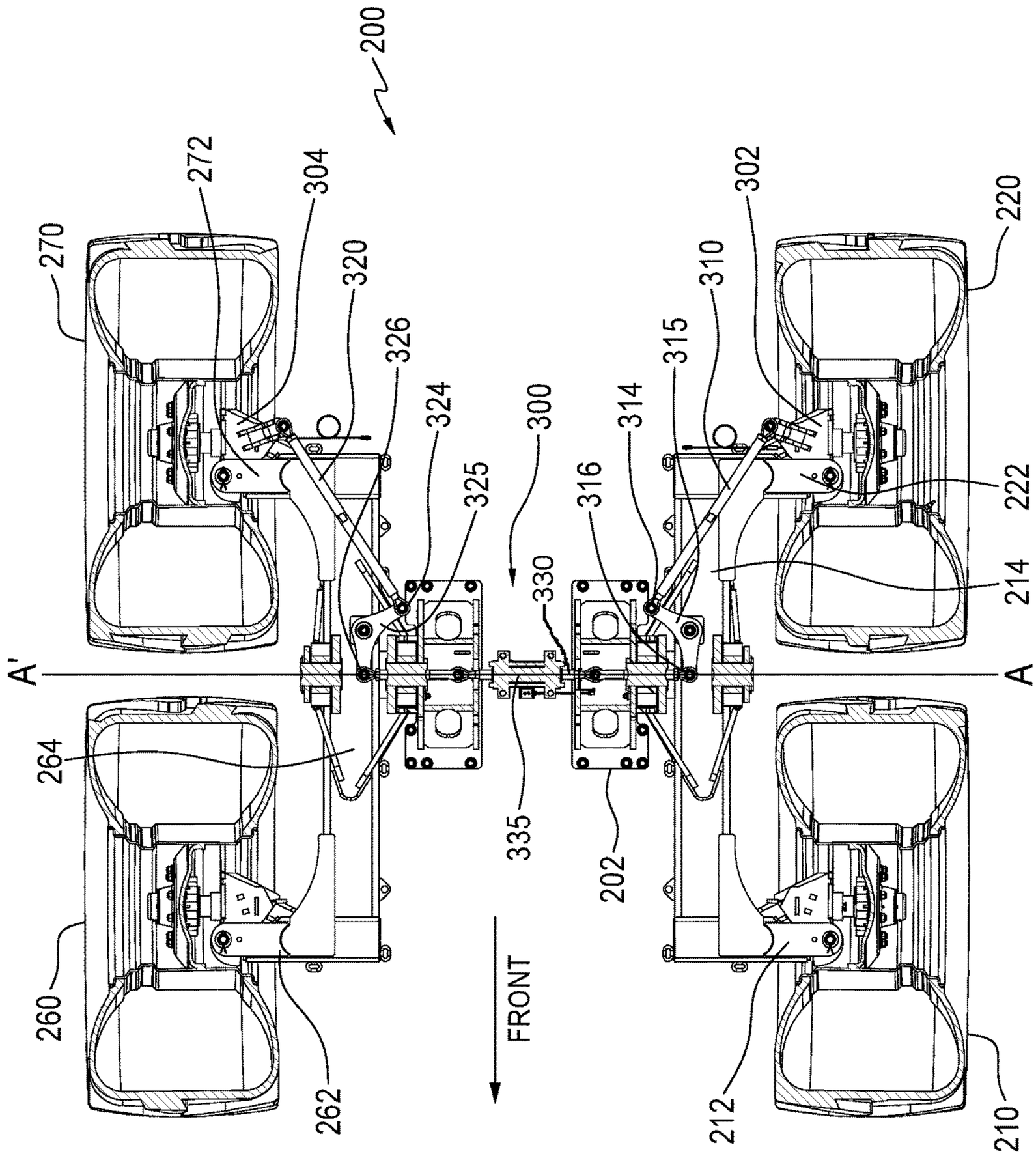
200
272
304
302
220
270
320
326
324
300
325
316
314
315
310
222
214
330
335
202
A'
A
264
260
262
212
210
FRONT

FIG. 10

TANDEM STEERING FOR A GRAIN CART

FIELD OF THE INVENTION

The present invention relates to a grain cart and more particularly to a wheel assembly for the grain cart to allow a set of tandem wheels on the grain cart to pivot together in combination.

BACKGROUND

Grain carts are typically used to transfer grain or other crop material from a combine harvester to a grain truck or bin. The grain cart typically comprises a storage hopper for crop material, an auger assembly for emptying crop material from the storage hopper and a set of ground wells so that the grain cart can be towed. While smaller grain carts may have a single pair of wheels, larger grain carts now commonly have a tandem set of wells (two wheels on each side of the grain cart). A tractor is commonly used to tow the grain cart with the auger assembly of the grain cart being driven off of the power take off (PTO) of the tractor (although hydraulics, etc. could also be used to power the auger assembly).

In use, the grain cart is towed by the tractor to a combine harvester where the crop material is unloaded from the combine harvester into the grain cart. With the crop material loaded into the storage hopper of the grain cart, the tractor can tow the grain cart to a truck, trailer, storage bin, etc. and use the auger system to unload the crop material from the grain cart.

Grain carts are getting larger and larger and some are now quite large. The larger grain carts now use tandem wheels on each side of these grain carts so that these larger grain carts are supported by four wheels in total. However, these tandem wheels can make it hard to turn the grain cart if the wheels are fixed in position. Instead, it is desirable to have a wheel assembly that allows the wheels to pivot when the grain cart is turned in order to allow the wheels of the grain cart to follow a curved path while the components used in the wheel assembly are relatively simply and still allow the wheels to be fixed in place to make it easier or even possible to reverse the grain cart.

BRIEF SUMMARY

In a first aspect, a grain cart is providing having a frame, a hitch assembly attached to a front end of the frame, a storage hopper provided on the frame, an auger assembly operatively connected to the storage hopper to discharge particulate material from the storage hopper out of the grain cart and a wheel assembly attached to the frame. The wheel assembly can include a first side suspension member, a second side suspension member, a first side front wheel rotatively and pivotally connected to a front end of the first side suspension member, a first side rear wheel rotatively and pivotally connected to a rear end of the first side suspension member, a second side front wheel rotatively and pivotally connected to a front end of a second side suspension member, a second side rear wheel rotatively and pivotally connected to a rear end of the second side suspension member, a first side steering link assembly operatively coupling the pivoting of the first side front wheel and the first side rear wheel so that the first side front wheel and the second side rear wheel pivot in opposite directions, a second side steering link assembly operatively coupling the pivoting of the second side front wheel and the second side rear wheel so that the second side front wheel and the second side rear wheel pivot in opposite directions and a unison linkage assembly operatively coupling the pivoting of the first side rear wheel and first side front wheel with the pivoting of the second side rear wheel and the second side front wheel.

In a further aspect, a grain cart can be provided wherein the first side steering link assembly includes a first side rear suspension link connected to a first steering arm of the first side rear wheel, a first side bell crank having a first side and a second side, the first side of the first side bell crank connected to the first side rear suspension link and a first side front suspension link connected to a steering arm of the first side front wheel and the second side of the first side bell crank.

In a further aspect, a grain cart can be provided wherein the first side steering link assembly includes a first side rear suspension link connected to a first steering arm of the first side rear wheel, a first side bell crank having a first side and a second side, the first side of the first side bell crank connected to the first side rear suspension link, and a first side front suspension link connected to a steering arm of the first side front wheel and the second side of the first side bell crank.

In a further aspect, a grain cart is provided wherein the unison linkage includes a first side cross linkage connected to a lower steering arm of the first side rear tire, a first cross bell crank having a first side and a second side, the first side connected to the first side cross linkage, a second cross bell crank having a first side and a second side, a second side cross linkage connected to a lower steering arm of the second side rear tire and the first side of the second cross bell crank and a rod member connected between the second side of the first cross bell crank and a second side of the second cross bell crank.

DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention is described below with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view of a grain cart;

FIG. **2** is a side view of the grain cart of FIG. **1**;

FIG. **3** is a top view of the grain cart of FIG. **1**;

FIG. **4** is a front view of the grain cart of FIG. **1** with the auger assembly in an operating position;

FIG. **5** is a front view of the grain cart of FIG. **1** with the auger assembly in a transport position;

FIG. **6** is a partial view of the bottom of a storage hopper of a grain cart with openings to a transport assembly;

FIG. **7** is a partial view of the bottom of the storage hopper of FIG. **6** with the openings closed by gates; and

FIG. **8** is a perspective view of a wheel assembly of the grain cart of FIG. **1**;

FIG. **9** is a top view of the wheel assembly of FIG. **8**; and

FIG. **10** is a bottom view of the wheel assembly of FIG. **8**.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

FIGS. **1-5** illustrates a grain cart **10**. The grain cart **10** can have a frame **20**, ground wheels **210**, **220**, **260** and **270**, a hitch assembly **40**, a storage hopper **60** for storing crop material and an auger assembly **80**. Crop material can be loaded into the storage hopper **60** of the grain cart **10** for transport to another location. When the grain cart **10** has been towed by a tow vehicle to another location, the auger

assembly **80** can be used to unload the crop material from the storage hopper **60** out of the grain cart **10**.

The frame **20** can support the storage hopper **60** and the wheels **210**, **220**, **260** and **270** can be operatively attached to the frame **20**. The hitch assembly **40** can be connected to the front of the frame **20** and the hitch assembly **40** can then be hitched to a tow vehicle, such as a tractor (not shown), to tow the grain cart **10**.

The storage hopper **60** has an interior portion for storing crop material. The upper side walls **62** of the storage hopper **60** can be relatively vertical while the lower walls **64** can be angled inwards to direct crop material into a center portion **66** at the bottom of the hopper **60**. Crop material loaded into the storage hopper **60** will be directed by gravity towards the center portion **66** in the bottom of the storage hopper **60**.

FIGS. **6** and **7** shows the center portion **66** in the bottom of the storage hopper **60**. Typically, a screen can be provided over the center portion **66**, but it is not shown in these figures to better illustrate the components in the center portion **66**. The center portion **66** of the storage hopper **60** can have a series of selectively openable gates **72** and corresponding openings **74** beneath the gates **72**. Beneath these openings **74** a transport assembly **70** for moving crop material that has fallen through the openings **74** and into the transport assembly **70** can be provided. The transport assembly **70** can move crop material that has fallen through the openings **64** towards the front of the grain cart **10** and into the auger assembly **80**. In the auger assembly **80**, the crop material can be moved up the auger assembly **80** to be discharged out of the grain cart **10**. The transport assembly **70** is typically a pair of augers and corresponding auger housings, but it can also be a conveyor belt, etc. However, in some grain cart **10**, such as corner-auger designs, the intake of the auger assembly **80** can be provided beneath the openings **74** and the transport assembly **70** can be a hopper, passage, etc. that directs crop material into the intake of the auger assembly **80**.

FIG. **4** illustrates a front view of the grain cart **10** where the auger assembly **80** is in an operating position ready to discharge crop material out of the grain cart **10** and into an adjacent truck, trailer, storage bin, etc. and FIG. **5** shows the auger assembly **80** folded up into a transport position. The auger assembly **80** can have a lower auger section **110** and an upper auger section **120**. When the auger assembly **80** is in the operating position, the upper auger section **120** and the lower auger section **110** can be positioned coaxial to one another.

The lower auger section **110** and the upper auger section **120** can each have a driveshaft and auger flighting within. The auger fighting in the lower auger section **110** will convey crop material up the lower auger section **110** and the auger fighting in the upper auger section **120**. The lower auger section **110** can have an intake end **112** that is joined with the outlet of the transport assembly **70** so that crop material that has reached the end of the transport assembly **70** is conveyed into the intake end **112** of the lower auger section **110**. This crop material will then be conveyed up the lower auger section **110** by the flighting in the lower auger section **110** until it reaches a top end **114** of the lower auger section **110**. From the top end **114** of the lower auger section **110**, the crop material can be transferred to the bottom end **122** of the upper auger section **120** and the flighting in the upper auger section **120** can convey the crop material up the upper auger section **120** to a discharge end **124** of the upper auger section **120**.

The discharge end **124** of the upper auger section **120** can be pivotally connected to a discharge assembly **140**. A spout **150** can be provided on the discharge assembly **140** to direct the flow of crop material exiting from the discharge end **140** of the upper auger section **120**.

When the grain cart **10** is to be transported, especially over relatively long distances, the upper auger section **120** can be pivoted around a pivot hinge **130** so that the upper auger section **120** is no longer coaxial with the lower auger section **110**, but rather, rotated around the hinge **130** to be placed closer to parallel with the lower auger section **110** so that the upper auger section **120** does not extend significantly beyond the side of the storage hopper **60** when the grain cart **10** is in the transport position.

FIG. **8** illustrates a perspective view of the wheel assembly **200** connected to the frame **20** and used to support the frame **20**, the storage hopper **60** and the auger assembly **80**. The wheel assembly **200** has a first side front wheel **210** and a first side rear wheel **220**, both of which are positioned on a first side of the wheel assembly **200**. There is also a second side front wheel **260** and a second side rear wheel **270**, both of which are positioned on a second side of the wheel assembly **200**. The wheel assembly **200** allows the wheels **210**, **220**, **260**, **270**, to freely turn when the grain cart **10** is being pulled through a field and being turned by the tow vehicle, the wheels **210**, **220**, **260**, **270** are all operatively connected to cause the wheels **210**, **220**, **260**, **270** to turn in unison so that the both the wheels **210** and **220** on the first side of the wheel assembly **200** and wheels **260** and **270** on the second side of the wheel assembly **200** pivot and follow a curved path to allow the grain cart **10** to be turned easier.

A center section **202** of the wheel assembly **200** can be provided that is attached to the frame **20** so that the center section **202** remains fixed relative to the frame **20**. The first side front wheel **210** and the first side rear wheel **220** are operatively connected to a front end **212** and a rear end **222** of a first side suspension member **214**, respectively. The second side front wheel **260** and the second side rear wheel **270** are rotatively connected to a front end **262** and a rear end **272** of a second side suspension member **264**, respectively.

The first side front wheel **210** and the first side rear wheel **220** are rotatively and pivotally connected to the front end **212** and the rear end **222** of the first side suspension member **214**, respectively. The wheels **210**, **220** are rotatively connected such that the wheels **210**, **220** can rotate around the center of the wheel **210**, **220** allowing the grain cart **10** to move forwards and backwards. The wheels **210**, **220** are pivotally connected to the first side suspension member **214** such that wheels **210**, **220** can pivot around a vertical axis and turn in relation to the grain cart **10** and more particularly relative to the first side suspension member **214** and the frame **20** of the grain cart **10**. Similarly, the second side front wheel **260** and the second side rear wheel **270** are rotatively and pivotally connected to the front end **262** and the rear end **272** of the second side suspension member **264**, respectively.

The first side suspension member **214** and the second side suspension member **264** can be pivotally attached to the center section **202** so that the first side suspension member **214** and the second side suspension member **264** can pivot around a pivot axis AA' passing horizontally through the center section **202** and perpendicular to a direction of travel of the grain cart **10**. In this manner, the first side suspension member **214** can pivot around this pivot axis AA', causing the first side front wheel **210** and the first side rear wheel **220** to be able to angle upwards and downwards relative to the frame **20** of the grain cart **10** and the second side suspension member **264** can pivot around the pivot axis AA', causing the second side front wheel **260** and the second side rear wheel **270** can to be able to be angled upwards and downwards

relative to the frame **20** of the grain cart **10** to compensate for changes in the terrain the grain cart **10** is being pulled over. The pivoting of the first side suspension member **214** and therefore the angling of the first side front wheel **210** and the first side rear wheel **220** can be independent from the pivoting of the second side suspension member **264** and therefore the angling of the second side front wheel **260** and the second side rear wheel **270**.

FIG. **9** illustrates a top view of the wheel assembly **200** showing a first side steering link assembly **280** and a second side steering link assembly **290**. The first side steering link assembly **280** and the second side steering link assembly **290** can be positioned above the first side suspension member **214** and the second side suspension member **264**, respectively. The first side steering link assembly **280** can be used to coordinate the pivoting of the first side front wheel **210** and the first side rear wheel **220** in tandem and the second side steering link assembly **290** can be used to coordinate the pivoting of the second side front wheel **260** and the second side rear wheel **270** in tandem.

The first side steering link assembly **280** can include a first side rear suspension link **282**, a first side bell crank **285**, and a first side front suspension link **288**. The first side rear suspension link **282** can be connected between a rear steering arm **226** of the first side rear wheel **220** to pivot the first side rear wheel **220** relative to the first side suspension member **214** and a first side **284** of the first side bell crank **285**. The first side rear suspension link **282** can be an adjustable tie rod. A first side front suspension link **288** can be connected between a front steering arm **216** of the first side front wheel **210** to pivot the first side front wheel **210** relative to the first side suspension member **214** and a second side **286** of the first side bell crank **285**. The first side **284** and the second side **286** of the first side bell crank **285** can be positioned approximately 180° from each other. The first side front suspension link **288** can be an adjustable tie rod.

In this manner, when the first side rear wheel **210** pivots, such as when the grain cart **10** is being towed through a curving path (i.e. turn), the pivoting of the first side rear wheel **220** will move the rear steering arm **226**, which in turn will move the first side rear suspension link **282** connected to the first side **284** of the first side bell crank **285** and thereby rotate the first side bell crank **285**. The rotation of the first side bell crank **285** will move the first side front suspension link **288** connected to the second side **286** of the bell crank **285**, which in turn will move the front steering arm **216** and pivot the first side front wheel **210**. Because of the configuration of the first side front suspension link **288**, the first side bell crank **285** and the first side rear suspension link **282**, the first side bell crank **285** will reverse the direction of motion from the first side rear suspension link **282** and the first side front suspension link **288** and therefore the first side front wheel **210** and the first side rear wheel **220** will be pivoted in opposite directions. For example, when the first side rear wheel **220** pivots out from a centerline of the grain cart **10**, the first side front wheel **210** is pivoted in towards the centerline of the grain cart **10** by the first side steering link assembly **280** and vice versa.

Similarly, the second side steering link assembly **290** can have a second side rear suspension link **292**, a second side bell crank **295** and a second side front suspension link **298**. The second side rear suspension link **292** can be connected between a rear steering arm **276** of the second side rear wheel **270** to pivot the second side rear wheel **270** relative to the second side suspension member **264** and a first side **274** of the bell crank **265**. The second side rear suspension link **292** can be an adjustable tie rod. A second side front suspension link **292** can be connected between a front steering arm **266** of the second side front wheel **260** to pivot the second side front wheel **260** relative to the second side suspension member **264** and a second side **296** of the second side bell crank **295**. The first side **294** and the second side **296** of the second side bell crank **295** can be positioned approximately 180° from one another. The second side front suspension link **292** can be an adjustable tie rod.

In this manner, when the second side rear wheel **270** pivots, such as when the grain cart **10** is being towed through a turn, the pivoting of the second side rear wheel **270** will move the rear steering arm **276**, which in turn will move the second side rear suspension link **292** connected to the first side **294** of the second side bell crank **295** and thereby rotate the second side bell crank **295**. The rotation of the second bell crank **295** will move the second side front suspension link **298** connected to the second side **296** of the second side bell crank **295**. The moving second side front suspension link **298** will in turn move the front steering arm **266** and pivot the second side front wheel **260**. Because of the configuration of the second side front suspension link **298**, the bell crank **295** and the second side rear suspension link **292**, the second side bell crank **295** will reverse the direction of motion from the second side rear suspension link **292** and the second side front suspension link **298** and therefore the second side front wheel **260** and the second side rear wheel **270** will pivot in opposite directions. For example, when the second side rear wheel **270** pivots out from a centerline of the grain cart **10**, the second first side front wheel **260** is pivoted in towards the centerline of the grain cart **10** and vice versa.

In addition to the wheels **210**, **220**, **260** and **270** on each side of the wheel assembly **200** being operatively coupled together so that the wheels **210**, **220**, **260** and **270** on each side of the wheel assembly **200** pivot in conjunction, the steering components on the first side of the wheel assembly **200** and the steering components on the second side of the wheel assembly **200** can be operatively connected so that pivoting of the first side front wheel **210** and the first side rear wheel **220** will cause the second side front wheel **260** and the second side rear wheel **270** to pivot as well and vice versa.

The pivoting of the first side suspension member **214** relative to the center section **202** will not affect the operation of the first side steering link assembly **280** because the first side rear suspension link **282**, the first side bell crank **285** and the first side front suspension link **288** will remain fixed in position relative to the first side suspension member **214** as the first side suspension member **214** pivots relative to the center section **202**. Similarly, the pivoting of the second side suspension member **264** relative to the center section **202** will not affect the operation of the second side steering link assembly **290** because the second side rear suspension link **292**, the second side bell crank **295** and the second side front suspension link **298** will remain fixed in position relative to the second side suspension member **264** as the second side suspension member **264** pivots relative to the center section **202**.

FIG. **10** is a bottom view of the wheel assembly **200** and a unison linkage assembly **300** operatively coupling the pivoting of the wheels **210**, **220** on the first side of the wheel assembly **200** with the pivoting of the wheels **260**, **270** on the second side of the wheel assembly **200**. The unison linkage assembly **300** can connect the first side rear wheel **220** and the second side rear wheel **270** so that the pivoting of one of these two wheels **220**, **270** causes the other wheel **270**, **220** to pivot as well. A first side cross linkage **310** can

be connected between a lower steering arm **302** of the first side rear wheel **220** and able to pivot the first side rear wheel **220** relative to the first side suspension member **214** and a first side **314** of a first cross bell crank **315**. Similarly, a second side cross linkage **320** can be connected between a lower steering arm **304** of the second side rear wheel **270** and able to pivot the second side rear wheel **270** relative to the second side suspension member **264** and a first side **324** of a second cross bell crank **325**. A rod member **330** can be connected between the a second side **316** of the first cross bell crank **315** and a second side **326** of the second cross bell crank **325**.

The rod member **330** can pass through a double rod end hydraulic cylinder **335** so that the double rod end cylinder **335** can move the rod member **330** in either direction, lock the rod member **330** in place or allow the rod member **330** to "float" or move freely back and forth in the double rod end cylinder **335**. The double rod end hydraulic cylinder **335** can be provided in the center section **202** of the wheel assembly **200**.

The rod member **330** can be aligned with the pivot axis AA' so that the rod member **330** is at the center of the pivot point between the first side suspension member **214** and the center section **202** and at the center of the pivot point between the second side suspension member **264** and the center section **202** so that the first side suspension member **214** and the second side suspension member **264** pivot around the rod member **330**.

The first side **314** and the second side **316** of the first cross bell crank **315** can be provided at an angle other than 180° so that the first cross bell crank **315** can alter the direction of motion from the first side cross linkage **310** and the rod member **330**. The first side **324** and the second side **236** of the second cross bell crank **325** can also be provided at an angle other than 180° so that the second cross bell crank **325** can alter the direction of motion from the second side cross linkage **320** and the rod member **330**.

When the double rod end hydraulic cylinder **335** is placed in the "float" mode, the rod member **330** can move freely through the double rod end hydraulic cylinder **335**. The rod member **330** will mechanically couple the first cross bell crank **315** and the second cross bell crank **325**, but the rod member **330** will be able to move freely. When the first side rear wheel **220** pivots out from the centerline of the grain cart **10**, the lower steering arm **302** connected to first side rear wheel **220** will move the first side cross linkage **310** which will in turn rotate the first cross bell crank **315**. As the first cross bell crank **315** rotates, the first cross bell crank **315** will pull the rod member **330** and the rod member will in turn rotate the second cross bell crank **325**. As the second cross bell crank **325** rotates, the second cross bell crank **325** will push the second side cross linkage **320** which will in turn push on the steering arm **304** of the second side rear wheel **270** which will pivot the second side rear wheel **270** in the same direction as the first side rear wheel **220** is pivoting, causing the second side rear wheel **270** to pivot in towards the centerline of the grain cart **10**.

The effect of the pivoting of the first side suspension member **214** and the second side suspension member **264** relative to the center section **202** can be reduced by the placement of the rod member **330** along the pivot axis AA'. Unlike the first side steering link assembly **280** and the second side steering link assembly **290** that can move entirely with the first side suspension member **214** and the second side suspension member **264**, respectively, the unison linkage assembly **300** has to connect from the first side suspension member **214** across the center section **202** and to the second side suspension member **264**. Both the first side suspension member **214** and the second side suspension member **264** can pivot relative to the center section **202** and independently of each other. By having the rod member **330** extend along the pivot axis AA' and ends of the rod member **330** extend out of the center section **202**, the first cross bell crank **315** can remain fixed in position relative to the first side suspension member **214** and the second cross bell crank **325** can remain fixed in position relative to the second side suspension member **264**. This will allow the first cross bell crank **315**, the first side cross linkage **310** and the steering arm **302** of the first side rear wheel **220** to remain fixed in position relative to the first side suspension member **214** as the first side suspension member **264** pivots relative to the center section **202** and the second cross bell crank **325**, the second side cross linkage **320** and the lower steering arm **304** of the second side rear wheel **270** to remain fixed in position relative to the second side suspension member **264** as the second side suspension member **264** pivots relative to the center section **202**.

The rod member **330** will stay in position along the pivot axis AA' and the where the rod member **330** connects to the second side **316** of the first cross bell crank **315** the end of the rod member **330** can be pivotally connected so that the end of the rod member **330** can rotate relative to the second side **316** of the first cross bell crank **315** allowing the first cross bell crank **315** to be fixed in position relative to the first side suspension member **214** and move with the pivoting of the first side suspension member **214**. The connection between the end of the rod member **330** and the second side **316** of the first cross bell crank **315** could be a spherical bearing so that the rod member **330** and the second side **316** allow more relative motion than just rotational motion. In a similar manner, where the rod member **330** connects to the second side **326** of the second cross bell crank **325** the end of the rod member **330** can be pivotally connected so that the end of the rod member **330** can rotate relative to the second side **326** of the second cross bell crank **325** allowing the second cross bell crank **325** to be fixed in position relative to the second side suspension member **264** and move with the pivoting of the second side suspension member **264**. The connection between the end of the rod member **330** and the second side **326** of the second cross bell crank **325** could be a spherical bearing so that the rod member **330** and the second side **326** allow more relative motion than just rotational motion.

The unison linkage assembly **300** will cause both the first side rear wheel **220** and the second side rear wheel **270** to pivot in the same direction. When one of the first side rear wheel **220** and the second side rear wheel **270** is pivoted, such as when the tow vehicle turns the grain cart **10**, and the double end hydraulic cylinder **335** is in "float" mode, the other of the second side rear wheel **270** and the first side rear wheel **220** will be pivoted in the same direction.

Referring again to FIG. **9**, when the unison linkage assembly **300** causes the first side rear wheel **220** and the second side rear wheel **270** to pivot in unison, the first side steering link assembly **280** will cause the first side front wheel **210** to pivot in an opposite direction to the first side rear wheel **220** and the second side steering link assembly **290** will cause the second side front wheel **260** to pivot in an opposite direction to the second side rear wheel **270**.

To back up the grain cart **10** with the tow vehicle, the rod member **330** can be locked in place by the double end hydraulic cylinder **335**, preventing the first side rear wheel **220** and the second side rear wheel **270** from pivoting. Because the first side rear wheel **220** is being held in place

by the unison linkage assembly **300**, the first side steering link assembly **280** will also prevent the first side front wheel **210** from pivoting and the second side steering link assembly **290** will prevent the second side front wheel **260** from pivoting.

The double end hydraulic cylinder **335** can also be used to pivot the wheels **210**, **220**, **260**, **270** as desired. By routing the hydraulic fluid to the double end hydraulic cylinder **335** hydraulic fluid, the double end hydraulic cylinder **335** can be used to force the rod member **330** to one side or the other, thereby pivoting all of the wheels **210**, **220**, **260**, **270**. This can be useful in packing up the grain cart **10** when it has to be backed into a specific position instead of straight back or maneuvering the grain cart **10** in a relatively tight space.

The linkages can be adjustable in length so that the amount the first side front wheel **210** pivots relative to the first side rear wheel **220** and the amount the second side front wheel **260** pivots relative to the second side rear wheel **270** can be adjusted and set to a desired amount. The first side rear suspension link **282** and/or the first side front suspension link **288** can be an adjustable links where the length of the first side rear suspension link **282** and/or the first side front suspension link **288** can be increased or decreased. This allows a person to adjust or "tune" the positioning of the first side front wheel **210** relative to the first side rear wheel **220** to align the first side front wheel **210** and the first side rear wheel **220** to both be pointed straight ahead when the grain cart **10** is being pulled forward. Similarly, the second side rear suspension link **292** and/or the second side front suspension link **298** can be an adjustable links where the length of the second side rear suspension link **292** and/or the second side front suspension link **298** can be increased or decreased. This allows a person to adjust or "tune" the positioning of the second side front wheel **260** relative to the second side rear wheel **270** to align the second side front wheel **260** and the second side rear wheel **270** to both be pointed straight ahead when the grain cart **10** is being pulled forward. This can also be used to ensure the wheels **210**, **220** on the first side of the grain cart **10** are parallel with the wheels **260**, **270** on the second side of the grain cart when the grain cart **10** is being pulled straight ahead. This can ensure the tires are running true and pointed straight ahead when the grain cart **10** is being pulled directly ahead. This can reduce or eliminate any side loading on the tires, reduce tire wear and improve the performance of the grain cart **10**.

The unison link assembly **300** can also be configured so that the amount the first side rear wheel **220** pivots relative to the second side rear wheel **270** can be set and vice versa. The first side cross linkage **310** and the second side cross linkage **320** can be adjustable in length so that the first side rear wheel **220** pivots relative to the second side rear wheel **270** can be positioned parallel to one another when the grain cart **10** is moving directly forward. The configuration of the first side cross linkage **310** and the second cross bell crank **325** can be chosen so that the wheels on the outside of a turn to pivot less than the wheels on the inside of the grain cart **10** to pivot when the grain cart **10** is turning with the wheels on the outside of the turn turning less than the wheels on the inside of the turn. This can be accomplished by choosing the size of the first cross bell crank **315** and the second cross bell crank **325**. By choosing a first cross bell crank **315** with a distance between the pivot point of the first cross bell crank **315** and the first side **314** of the first cross bell crank **315** that is greater than the distance between the pivot point of the first cross bell crank **315** and the second side **316** of the first cross bell crank **315** and a second cross bell crank **325** with a distance between the pivot point of the second cross bell crank **325** and the first side **324** of the second cross bell crank **325** that is greater than the distance between the pivot point of the second cross bell crank **325** and the second side **326** of the second cross bell crank **325** this can be achieved. Having the amount the different wheels pivot curing a turn can reduce the amount of tire scrub on the ground and reduce the towing force needed to tow the grain cart **10**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous changes and modifications will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all such suitable changes or modifications in structure or operation which may be resorted to are intended to fall within the scope of the claimed invention.

What is claimed is:

1. A grain cart comprising:

a frame;

a hitch assembly attached to a front end of the frame;

a storage hopper provided on the frame;

an auger assembly operatively connected to the storage hopper to discharge particulate material from the storage hopper out of the grain cart; and

a wheel assembly attached to the frame, the wheel assembly comprising:

a first side suspension member;

a second side suspension member;

a first side front wheel rotatively and pivotally connected to a front end of the first side suspension member;

a first side rear wheel rotatively and pivotally connected to a rear end of the first side suspension member;

a second side front wheel rotatively and pivotally connected to a front end of the second side suspension member;

a second side rear wheel rotatively and pivotally connected to a rear end of the second side suspension member;

a first side steering link assembly operatively coupling the pivoting of the first side front wheel and the first side rear wheel so that the first side front wheel and the first side rear wheel pivot in opposite directions;

a second side steering link assembly operatively coupling the pivoting of the second side front wheel and the second side rear wheel so that the second side front wheel and the second side rear wheel pivot in opposite directions; and

a unison linkage assembly operatively coupling the pivoting of the first side rear wheel and first side front wheel with the pivoting of the second side rear wheel and the second side front wheel,

wherein the unison linkage assembly comprises:

a first side cross linkage connected to a lower steering arm of the first side rear wheel;

a first cross bell crank having a first side and a second side, the first side connected to the first side cross linkage;

a second cross bell crank having a first side and a second side;

a second side cross linkage connected to a lower steering arm of the second side rear wheel and the first side of the second cross bell crank; and

a rod member connected between the second side of the first cross bell crank and the second side of the second cross bell crank.

2. The grain cart of claim 1 wherein the first side steering link assembly comprises:

a first side rear suspension link connected to a first steering arm of the first side rear wheel;

a first side bell crank having a first side and a second side, the first side of the first side bell crank connected to the first side rear suspension link; and

a first side front suspension link connected to a steering arm of the first side front wheel and the second side of the first side bell crank.

3. The grain cart of claim 2 wherein the second side steering link assembly comprises:

a second side rear suspension link connected to a first steering arm of the second side rear wheel;

a second side bell crank having a first side and a second side, the first side of the second side bell crank connected to the second side rear suspension link; and

a second side front suspension link connected to a steering arm of the second side front wheel and the second side of the second side bell crank.

4. The grain cart of claim 2 wherein the first side of the first side bell crank is 180° from the second side of the first side bell crank.

5. The grain cart of claim 2 wherein the first side of the second side bell crank is 180° from the second side of the first side bell crank.

6. The grain cart of claim 1 wherein the first side steering link assembly is positioned above the first side suspension member and the second side steering link assembly is positioned above the second side suspension member.

7. The grain cart of claim 1 wherein a double end hydraulic cylinder is provided acting on the rod member.

8. The grain cart of claim 1 wherein the wheel assembly further comprises a center section attached to the frame and the first side suspension member is pivotally connected to a first side of the center section so that the first side suspension member pivots around a pivot axis and the second side suspension member is pivotally connected to a second side of the center section so that the second side suspension member pivots around the pivot axis.

9. The grain cart of claim 8 wherein the rod member is aligned along the pivot axis.

10. The grain cart of claim 9 wherein the rod member passes through the center section and ends of the rod member extend out of the center section to the first side suspension member and the second side suspension member.

11. The grain cart of claim 10 wherein a first end of the rod member is pivotally connected to the second side of the first cross bell crank and a second end of the rod member is pivotally connected to the second side of the second cross bell crank.

12. The grain cart of claim 11 wherein the first side steering link assembly comprises:

a first side rear suspension link connected to a first steering arm of the first side rear wheel;

a first side bell crank having a first side and a second side, the first side of the first side bell crank connected to the first side rear suspension link; and

a first side front suspension link connected to a steering arm of the first side front wheel and the second side of the first side bell crank,

and wherein the second side steering link assembly comprises:

a second side rear suspension link connected to a first steering arm of the second side rear wheel;

a second side bell crank having a first side and a second side, the first side of the second side bell crank connected to the second side rear suspension link; and

a second side front suspension link connected to a steering arm of the second side front wheel and the second side of the second side bell crank,

and wherein the first side rear suspension link, the first side bell crank and the first side front suspension link remain fixed in position relative to the first side suspension member as the first side suspension member pivots relative to the center section.

13. The grain cart of claim 12 wherein the second side rear suspension link, the second side bell crank and the second side front suspension link remain fixed in position relative to the second side suspension member as the first side suspension member pivots relative to the center section.

14. The grain cart of claim 13 wherein the first side cross linkage and the first cross bell crank remain fixed in position relative to the first side suspension member connected as the first side suspension member pivots relative to the center section.

15. The grain cart of claim 14 wherein the second side cross linkage and the second cross bell crank remain fixed in position relative to the second side suspension member connected as the second side suspension member pivots relative to the center section.

16. The grain cart of claim 12 wherein the first side rear suspension link and the second side rear suspension link are adjustable in length.

17. The grain cart of claim 12 wherein the first side front suspension link and the second side front suspension link are adjustable in length.

18. The grain cart of claim 1 wherein a distance between the first side of the first cross bell crank and a pivot connection of the first cross bell crank is greater than a distance between the second side of the first cross bell crank and the pivot connection of the first cross bell crank.

19. The grain cart of claim 1 wherein a distance between the first side of the second cross bell crank and a pivot connection of the second cross bell crank is greater than a distance between the second side of the second cross bell crank and the pivot connection of the second cross bell crank.

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